



Increase of gas fields output efficiency due to creation of new automation facilities

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1. ABSTRACT

The main volume of gas in joint-stock company "Gazprom" is extracted from the wells of the Cenomanian deposits of the gas fields, equipped mainly with tubings from the pipes of large diameters of 114 or 168 mm. The largest and unique gas fields of Russia - Medvezhie, Urengoykoe, Yamburgskoe, - are in the final stage of development, being located inside the Polar Circle in the bleak climatic conditions. The operation of wells becomes more complicated due to the decreasing of pressure in the productive layer causing the liquid affluxion which leads to reduction of wells output. It is necessary to blow out the well to the technological torch line to remove the liquid from it, which leads to the gas loss and the environmental pollution.

The joint-stock company "Gazprom" in this situation recently is actively testing and implementing different technologies for removing of liquid from the wells to decrease the negative influence of its affluxion on wells operation process and to guarantee the stability of gas supply to the customers.

Only the wide usage of traditional and newly created technologies on the gas fields with implementation of monitoring and controlling systems is possible to ensure the stable operation of wells in this situation for the next 10-15 years and further on.

One of the advanced methods is operation of wells with the concentric tubing (dual tubing) [1,2].

A few years ago the main problem of this technology realization was the practically full deficiency of reliable equipment, capable to operate in the autonomous regime under the bleak climatic conditions of the Far North.

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2. BODY OF PAPER

The equipment for monitoring and control of wells technological operating regimes that can be successfully used for optimization of wells operation with the dual tubing was developed, tested and implemented on the gas fields inside the Polar Circle of JSC "Gazprom" subsidiaries during the last 5-6 years.

The set of telemechanics equipment is intended for constructing the automated systems for technological processes control on the enterprises of gas and oil industry.

Patented technologies and devices of firm "Vympel" combined with advanced world companies equipment make it possible to use this telemechanics system both on electrified objects, and on nonelectrified ones.

The real examples of successful implementation of this system on nonelectrified objects of the Far North are gas deposits of Kharvutinskaya and Aneryakhinskaya areas of Yamburgskiy Gas-Condensate Field (YGCF) of joint-stock company "Gazprom".

Figure 1 shows the block diagram of Telemechanics System of Gas Well Clusters (TS GWC) on Kharvutinskaya area of YGCF.

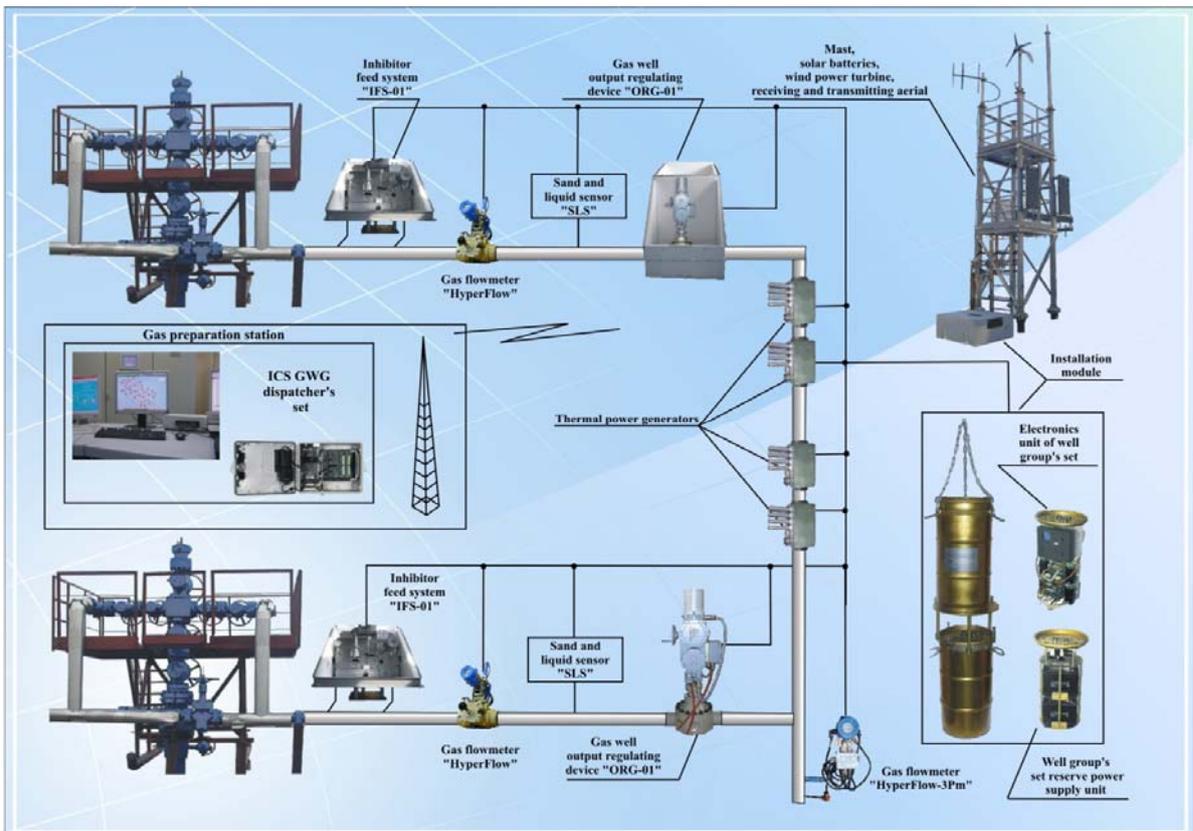


Figure. 1. Nonvolatile model of telemechanics system of gas well clusters.

The following subsystems and devices ensure the successful operation of the above represented telemechanics system:

1. Remote stations of TS GWC with power supply system;
2. Gas flowmeters;
3. Gas well output regulating devices;
4. Inhibitor feed systems;
5. Dispatcher set of TS GWC.

Nonvolatile telemechanics station (Fig. 2.)

Basic functions of nonvolatile telemechanics station (NTS) [3,4] are:

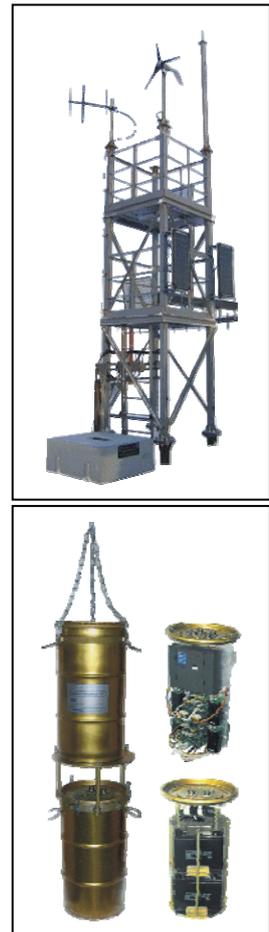
- power supply of well cluster components;
- data receiving and transmission by radio according to the set period of interrogation in the dispatcher set;
- executive devices control.

Electronics and reserve power supply modules are the basic elements of NTS. They are placed in tight containers which have an IP 66 protection level. Tight containers are installed in the installation module made from a pipe and submerged into the ground to stable temperature of the internal equipment from -5°C down to -10°C at a temperature of ambient air of -55 °C.

Wind power turbine, solar batteries and transmitting-receiving aerial are mounted on the mast.

Electronics and reserve power supply modules contains specially developed power controller, reserve lithium batteries, main batteries of two types – operating and bypass, charging controller of operating batteries and telemechanics controller. The developed power controller is used for the charge-discharge processes control of the batteries, for sequence of recyclable autonomous power supplies operation and for the inside temperature control of the module.

The autonomous power supplies (thermal power generators, wind power turbines and solar batteries) charge the bypass accumulators to power all system components.



*Figure 2.
Nonvolatile
telemechanics
station.*

Gas flowmeter “HyperFlow” with non-standard converging device (Fig. 3)

The non-standard converging device “NCD” is a proved solution for wells output control, which has many advantages in compare with the

orifice plate as a pressure differential measurement device:

- Decrease of the linear pipeline lengths.
- Considerable decrease of unrestorable pressure loss.
- Increase of wear resistance which allows to use it within the whole operating period of the well.
- Extension of flow rate dynamic range which allows to optimize the operating regimes of the well without flowmeter replacement during the whole operation period.
- Needless of the special heated container and exploitation with local thermostating due to the heat of the flowing through the pipeline medium.



Figure 3. Gas flowmeter "HyperFlow".

Inhibitor feed system "IFS-01" (Fig. 4)



Figure 4. Inhibitor feed system "IFS-01".

- Feeds the inhibitor into the pipeline either to prevent gas hydrate formation or to liquefy already existing hydrates.
- Feeds the inhibitor within the wide range of the rates and pressures.
- Measures the inhibitor flow rate that allows to use the complex algorithms of feed process control.
- Operates steadily in the low ambient temperature conditions.
- Is energy-saving device.

Gas well output regulating device "ORD-01" (Fig. 5)

- Regulates well output in the wide dynamic range.



- Is full-opening device.
- Has energy saving electric drive because of minimum torque at its own rod.
- Operates without autonomous heating and has the ambient protection level, similar to the flowmeter "HyperFlow".
- There are several types of electric drives with the torque from 200 to 10000 n/m.

Figure 5. Gas well output regulating device "ORD-01".

Dispatcher set (Fig. 6)

The dispatcher set is used for reception, archivation, visualization of the obtained information, and transmission of the commands to the electronics modules of the well cluster stations.

The dispatcher automated workplace (DAW) makes it possible to operate remotely the technological systems and processes of the enterprise using the authentic information in online regime.

The engineer automated workplace (EAW) makes it possible to configure, troubleshoot and plan the maintenance of the telemechanics equipment.

The information from the DAW online database is accessible by the OPC protocol by the external information systems. This protocol can be also used for external information systems control of enterprise technological processes.



Figure 6. Dispatcher set.

This well-tried equipment is proposed to supplement with dual-phase flowmeter DPF-01 and use them in the new arrangement for realization of the dual tubing technology of wells operation, for

monitoring and control of wells output in conditions of the liquid affluxion and destruction of the wellbore area.

This telemechanics system will completely exclude wells shutdown by reason of liquid affluxion and will increase stability and reliability of exploitation.

The telemechanics system is the automated complex, which solves the following tasks:

- the well operation parameters control at the each channel of the dual tubing: flow rate, pressure, temperature, liquid and sand content in the gas flow;
- regulation of the well operating regime with possibility of permanent or periodical liquid flow through one of the channels;
- maintenance of the set wells operating regime in the case of considerable pressure changes in the gathering main.

The principle scheme of the above complex is given in the Fig. 7.

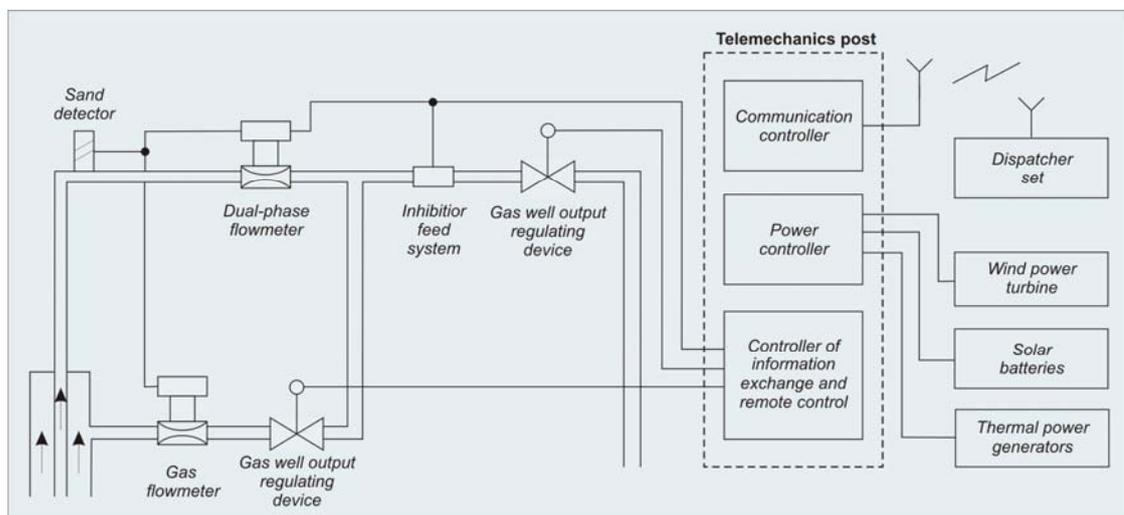


Figure 7. The principle scheme of gas wells with dual tubing operation.

It is configured from the above mentioned devices with addition of the new one - dual-phase flowmeter "DPF-01".



Dual-phase gas flowmeter "DPF-01" (Fig. 8)

Dual-phase gas flowmeter is a new device, in which the design solution for the dual-phase flow measurement by the method of variable pressure differential in two certified means of measurement -

Figure. 8. Dual-phase gas
flowmeter "DPF-01"

gas flowmeter "HyperFlow" and orifice plate meter of original construction is realized.

The principle scheme on Fig. 7 makes it possible to use several algorithms of well operation regimes and to select optimum taking into account the special features of given field, deposit, cluster or well.

The proposed technology and equipment for control of the wells operating regimes with dual concentric tubing realized in the automated complex allows to extend considerably the gas extraction period on the fields of decreasing output in conditions of low ambient temperatures and without grid power supply.

3. REFERENCES

1. Loss of formation energy control during the gas extraction at the Shebelin Gas Field /V.P. Maksimov and others // Gasovoe delo. – 1964. No. 8.
2. Development of technologies and technical facilities of exploitation and total overhaul of the wells at JSC "Gazprom" gas fields, including fields with decreasing output and with hard mining-and-geological conditions. / A.N. Kharitonov, V.I. Shulyatnikov and others. // Scientific research report, VNIIGAS, JSC "Gazprom". – 2005
3. Development of telemechanics complex devices for the gas well clusters without electric power supply/A.M. Derevyagin, A.E. Chernov, P.N. Francev, S.V. Zavyalov // Gas industry.-2004 No.10 – pp.13-16
4. Informative-measuring complex for the gas overpressure and temperature measurement at the gas wells of the Northern gas fields. / A.M. Derevyagin, A.P. Stepanov, Y.V. Komarov, A.E. Chernov, Z.S. Salikhov, P.L. Francev, S.V. Zavyalov // Science and technics in the gas industry. Special edition. Geology, drilling, development and gas preparation. – 2005 No. 3 – pp. 59-65.

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